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IN GLAUCOMA.

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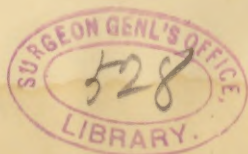
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THIS is more of a theoretical paper than a practical one. Theory is important for the interpretation of facts, but is worth little unless it can explain its own phenomena, and it must effect this without contradicting itself; accordingly the facts are sometimes made to suit the theory, rather than the theory the facts; and is acceptable on the whole, more for its plausibility than for its solidity. Darwin once advanced a theory in which he informed us that the reason why the bosom of a beautiful woman was an object of such peculiar delight, arises from the fact that all our first pleasurable sensations of warmth, sustenance and repose, are derived from that source. This theory had a fair run, until someone happened to reply that all who were brought up by hand and derived their first pleasurable sensations from a very different source, and as yet, not one of all these had ever been known to evince any very rapturous or amatory emotions at the sight of a wooden spoon or gum nipple.

Several theories have been evolved as to the cause of the rainbow, or colored rings of light which appear in glaucoma, principally by older authors, none by our modern writers, who simply refer to it as an existing fact, but do not explain its cause. The general inference being, that it is due to the increased tension, but its *modus operandi* is disputed.

It is spoken of as a prodromal symptom of glaucoma, which is an error, inasmuch as it may occur at any stage of glaucoma, *prior to the destruction of the cornea* from excessive inflammation. The impression probably originated before the differentiation between glaucoma inflammatorum, and glaucoma simplex, the latter not being recognized as glaucoma, but simply as a disease where there was increased tension with excavation of the optic nerve, without



inflammation and was considered a prodromal stage. It is in the first stage of glaucoma inflammatorum that the patient usually refers to the rainbow symptom.

The character of the symptom is described in text-books principally as a rainbow or ring of colored light, when the visual axes are directed toward a lamp or bright light. Not constant, appearing and disappearing during the course of the disease, regardless of the tension, *after it has once existed*, whether it be increased or temporarily decreased. Some books speak of shimmerings, or flying sparks of light in connection with it, but these are simply subjective symptoms due to muscæ volitantes, or retinal irritation, and should not be mentioned in connection with the halo symptom, except as a co-existing symptom; they are not pathognomonic of glaucoma, inasmuch as they exist in other conditions regardless of tension, and are not dependent on it.

I take the liberty to quote at length from a recent article on this subject, by Dr. S. O. Richey, of Washington, D. C., appearing in the July number of the ANNALS OF OPHTHALMOLOGY AND OTOTOLOGY, in which he says that "the cause of the halo would seem not to be in the retina itself, but in the media anterior to it. Its variability suggests the aqueous humor, or some surface subject to the influence of the aqueous humor, for it is in the *serum* of the blood that the chief deviation from the healthy standard is perceived, by the products of excretion which have not been eliminated. When the urates in the blood are in excess (uric acidemia), the same influences which determine their presence in the synovial fluid of the joints and their precipitation upon the serous surfaces operate in the eye which is more exposed to vicissitudes of temperature. Hence, variations of glaucoma halo, with variations of urates in the blood, might clearly occur without present change of intra-ocular tension," and claims these urates to exist in the form of "sodic chlorid combined with uric acid which forms shining rhombic prisms, and that the halo is produced by the reflection of rays of light on these urates." Having for his argument, the lunar halo, which according to the accepted theory, (Descartes) is owing to the refraction and reflection of rays of light by minute snow and ice crystals in the upper strata of air, and occurs in the presence of the cirrus, or ice-cloud, as an analogy. And further says that the transposition of colors, which are reversed in glaucoma, the red being on the outer margin instead of the inner margin, is "strong evidence that the cause of the glaucoma halo is to be looked for posterior to the iris, in accordance with the disposition of rays of

light passing through the aperture of a screen." If this be so, and the reversal of colors in the glaucoma halo be due to transposition, then the colors in the rainbow after a shower, which is anterior to the iris the same as the lunar halo, would be transposed also, and should be arranged the same as in the lunar halo; red on the inner margin, but it is not. It is red on the outer margin the same as the glaucoma halo, making it evident that the cause of the glaucoma halo is anterior to the iris exclusively, and makes the theory of the transposition of the former doubtful. According to the disposition of rays of light passing through an aperture in a screen, there is an inversion, the object is in an inverted one but no color or detail of it is transposed, a simple inversion of a circle or halo would make no perceptible change in its appearance, the colors retaining the same position as they did prior to the inversion. If it were due to the non-eliminated excretions from the serum of the blood, then its appearance would naturally be expected at any time in any disease of the eye where tension does not take part, and confined to people of rheumatic or gouty diathesis, which it is not. If it were due to precipitated urates on the retina, then we would expect to find some deposits with the ophthalmoscope which we do not. In synchysis scintillans we have particles of cholesterolin in the vitreous which are distinctly discernible as bright, glistening crystals, but produce no halo. The rainbow symptom does not exist except where there is, or has been increased tension, not moderate tension, but sufficient to interfere with the circulation and produce edema, tension which if not relieved, will ultimately destroy the eye. Tension produced artificially by pressure on the eye by the fingers produces a narrow ring of white light with a black center opposite to the points of pressure *but no color*. Great abnormal pressure such as we find in glaucoma, and which exists in no other disease or condition, leaves nothing but excessive tension, to which the production of the halo can be attributed and the presence of intra-ocular contents, be they urates or what not, must be excluded as a causative factor. Tension then, as the prime factor, its effect as the immediate cause, gives us ample clinical condition upon which to base its production. Some three years ago, during an operative course on pig's eyes, I noticed when putting the eye in the mask and screwing it down to get as near the normal tension as possible, that with increased pressure I had a glaucomatous eye to all intents and appearances. I do not refer to the tension of the sclerotic, but to the appearance and condition of the cornea which assumed at once the peculiar smoky

reflex characteristic of glaucoma. That this was not due to the forced approximation of the lens to the cornea on account of the pressure being made posterior to the equator, was afterward demonstrated. When the pressure is removed the reflex disappears, and the pupil becomes black again. That this reflex, sometimes wrongly spoken of as opacity, is due to the pressure forcing the natural fluids the eye may have acquired (from the slight disintegration of the tissues after enucleation) through and into the lamellæ of the cornea is obvious, and that this is possible or probable is patent when we look at the cornea histologically, and that the same thing exists in glaucoma is demonstrated by Fuch under the head of the "Anatomy of the Cornea of Glaucoma" in which he says, in the cornea the cloudiness is found to be edema. The most anterior of the lamellæ of the corneal stroma are pushed apart by fluid. *But the fluid is especially apt to be found under the form of minute drops between Bowman's membrane and the epithelium.*

We have here a demonstrated pathologic anatomical condition, which coincides and is demonstrated by natural laws in the production of the rainbow, during a shower consisting of all the prismatic colors, their production depending, as is well known, on a double refraction and a single reflection of the sun's rays on drops of water. The vividness of its colors is increased or decreased in ratio to the finer or coarser division of the said drops, often occurring as a complete circle in the spray arising from cascades or fountains. We have here then two identical conditions, with identical results its non or disappearance in the glaucomatous eye based on the same laws as for its non or disappearance in the atmosphere, these beads of water being especially apt to be formed between Bowman's membrane and the epithelium layer of the cornea, explains how we may have its appearance in the eye at either high or low tension. Once the eye has been subjected to intra-ocular tension to the degree of interfering with the circulation sufficiently to produce stasis and edema of the cornea, a sudden diminution of the tension, would not immediately relieve the edema of the cornea any more than the recovery of the heart of its former tone, or increased compensation, would cause the sudden or immediate disappearance of anasarca. So while the cause is removed the same conditions exist for some time after, and we have the halo during an interval of comparatively low tension. On the other hand its disappearance during enormously high tension is readily explained by the naturally increased edema,

causing a coalescence of these edematous beads of water forming a zone of liquid under the epithelium layer, which is finally lifted up in small blebs, destroying the proper relation of the parts for refraction, without which the colors cannot be produced as on a sheet of water there is nothing but a reflection.

To recapitulate: 1. There is no transposition of colors in the rainbow.

2. If the play of colors were due to the non-eliminated excretions of the blood, then we should have the symptom in other diseases of the eye in which tension is not a factor.

3. If it were due to deposits of urates on the retina, then at some time deposits should be discernible with the ophthalmoscope, which they are not.

4. It is, in my opinion, dependent on stasis and edema of cornea, the varying distinctness of said symptom, dependent on the varying stages of edema.

5. Its appearance in comparatively low tension being dependent on the non-absorption of the resulting edema of the cornea, from a previously high tension.

6. Its non or disappearance in enormously high tension is dependent on the naturally increased edema, causing a coalescence of the edematous beads of water under the epithelial layer, thus destroying the proper relation for refraction, without which the colors cannot be produced.

7. Intra-ocular contents must be excluded as a causative factor.

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